

Advanced Materials

Araldite® LY 556*/ Aradur® 917-1*/ Accelerator 960-1*

HOT CURING EPOXY MATRIX SYSTEM

Araldite® LY 556 is an epoxy resin
 Aradur® 917-1 is an anhydride hardener
 Accelerator 960-1 is used as an amine accelerator

APPLICATIONS	High performance composite parts		
PROPERTIES	Anhydride-cured, low-viscosity standard matrix system with extremely long pot life. The reactivity of the system is adjustable by variation of the accelerator content. The system is easy to process, has good fibre impregnation properties and exhibits excellent mechanical, dynamic and thermal properties.		
PROCESSING	Filament Winding Pultrusion Pressure Moulding		
PRODUCT DATA	Araldite® LY 556		
	Aspect (visual)	clear, pale yellow liquid	
	Epoxy index (ISO 3001)	5.30 - 5.45**	[Eq/kg]
	Viscosity at 25 °C (ISO 12058-1)	10000 - 12000 **	[mPa s]
	Density at 25 °C (ISO 1675)	1.15 - 1.20	[g/cm ³]
	Aradur® 917-1		
	Aspect (visual)	clear liquid	
	Viscosity at 25 °C (ISO 12058-1)	50 - 80**	[mPa s]
	Density at 25 °C (ISO 1675)	1.20 - 1.25	[g/cm ³]
	Accelerator 960-1		
	Aspect (visual)	light yellow liquid	
	Viscosity at 25 °C (ISO 2555)	120 - 250**	[mPa s]
	Density at 25 °C (ISO 1675)	0.95 - 0.97	[g/cm ³]

** Specified data are on a regular basis analysed. Data which is described in this document as 'typical' is not analysed on a regular basis and is given for information purposes only. Data values are not guaranteed or warranted unless if specifically mentioned.

STORAGE Provided that Resin LY 556, Aradur® 917-1 and Accelerator 960-1 are stored in a dry place in their original, properly closed containers at the storage temperature mentioned in the MSDS they will have the shelf lives indicated on the labels. Partly emptied containers should be closed immediately after use. Because Aradur 917 is sensitive to moisture, storage containers should be ventilated with dry air only.. Araldite® LY 556 which has crystallized and looks cloudy can be restored to its original state by heating to 60 - 80 °C.

* In addition to the brand name product denomination may show different appendices , which allows us to differentiate between our production sites: e.g. , BD = Germany, US = United States, IN = India, CI = China, etc.. These appendices are in use on packaging, transport and invoicing documents. Generally the same specifications apply for all versions. Please address any additional need for clarification to the appropriate Huntsman contact

TYPICAL SYSTEM DATA

PROCESSING DATA

MIX RATIO	Components	Parts by weight	Parts by volume
	Araldite® LY 556	100	100
	Aradur® 917-1	90	86
	Accelerator 960-1	2 - 5	2.5 - 6.0

We recommend that the components are weighed with an accurate balance to prevent mixing inaccuracies which can affect the properties of the matrix system. The components should be mixed thoroughly to ensure homogeneity. It is important that the side and the bottom of the vessel are incorporated into the mixing process. When processing large quantities of mixture the pot life will decrease due to exothermic reaction. It is advisable to divide large mixes into several smaller containers.

PROCESSING RECOMMENDATIONS

To simplify the mixing process the resin can be preheated to about 30 °C to 50 °C before adding the cold hardener. Hardener and accelerator can be premixed, thus allowing the use of two component mixing/metering equipment. The mix of hardener and accelerator has a shelf life of several days.

The processing of the system at elevated temperatures of 30 °C to 40 °C shows the best results. The gelation temperature should not be higher than absolutely necessary. A high gelation temperature induces high shrinkage and generates internal stresses.

INITIAL MIX VISCOSITY (HOEPLER, ISO 12058-1B)	[°C]	[mPas]
	at 25	600 - 1000
	at 40	200 - 300
	at 60	< 75

POT LIFE (TECAM, 65 % RH, 100 G)	[°C]	[h]	100:90:3	100:90:5
	at 23	[h]	56 - 60	22 - 26
	at 40	[h]	10 - 12	5 - 6

GEL TIME (HOT PLATE)	[°C]	[min]	100:90:3	100:90:5
	at 80	[min]	42 - 44	28 - 30
	at 90	[min]	28 - 30	17 - 18
	at 100	[min]	11 - 13	7 - 8
	at 120	[min]	3 - 4	2 - 3

VISCOSITY BUILD-UP (HOEPLER, ISO 12058-1B)	[°C]	[mPas]	100:90:3	100:90:5
	at 40	to 1500	200 - 205	115 - 120
	at 40	to 3000	320 - 325	210 - 215
	at 60	to 1500	120 - 122	58 - 60
	at 60	to 3000	135 - 140	68 - 70
	at 80	to 1500	30 - 32	20 - 30
	at 80	to 3000	32 - 34	22 - 23

TYPICAL CURE CYCLES	Gelation either or	2 - 4 h at 80 °C
	Post-cure either or	1 - 3 h at 90 °C
		4 - 8 h at 120 °C
		2 - 8 h at 140 °C

Cure temperatures in excess of about 130 °C cause brown discolouration but do not impair the properties of the product.

PROPERTIES OF THE CURED, NEAT FORMULATION

The values below were obtained with a formulation using 3 pbw Accelerator AC 960-1
Unless otherwise stated, the processing schedule for the samples tested was gelation for 4 hours at 80 °C and post-cured for 4 hours at 140 °C.

GLASS TRANSITION TEMPERATURE (T_G) (IEC 1006, 10 K/MIN)	Cure:		T _G DSC [°C]
	4 h 80 °C		95 - 100
	1 h 100 °C		110 - 115
	4 h 100 °C		115 - 120
	1 h 120 °C		125 - 130
	4 h 80 °C + 4 h 120 °C		130 - 135
	4 h 80 °C + 4 h 140 °C		133 - 138
TENSILE TEST (ISO 527)	Tensile strength	[MPa]	88 - 91
	Elongation at tensile strength	[%]	5.0 - 6.0
	Ultimate strength	[MPa]	87 - 94
	Ultimate elongation	[%]	5.5 - 6.5
	Tensile modulus	[MPa]	3100 - 3200
FLEXURAL TEST (ISO 178)	Flexural strength	[MPa]	150 - 155
	Elongation at flexural strength	[%]	6.5 - 7.0
	Ultimate strength	[MPa]	148 - 155
	Ultimate elongation	[%]	6.5 - 7.0
	Flexural modulus	[MPa]	3200 - 3350
FRACTURE PROPERTIES BEND NOTCH TEST (PM 258-0/90)	Fracture toughness K1C	[MPa√m]	0.57 - 0.60
	Fracture energy G _{1C}	[J/m ²]	110 - 120
WATER ABSORPTION (ISO 62)	<i>Immersion:</i>	<i>Cure:</i>	<i>4h 80 + 4h 140 °C</i>
	1 days H ₂ O 23 °C	[%]	0.10 - 0.15
	10 days H ₂ O 23 °C	[%]	0.35 - 0.40
	60 min H ₂ O 100 °C	[%]	0.20 - 0.25
POISSON'S RATIO		[μ]	0.35

PROPERTIES OF THE CURED, REINFORCED FORMULATION

Unless otherwise stated, the figures given are for pressed laminate samples comprising 12 layers (3.1 - 3.25 mm) of E-glass fabric UD, 425 g/m², fibre volume content 61 - 64 %.

FLEXURAL TEST (ISO 178)	Flexural strength	[MPa]	1000 – 1100
	Elongation at surface	[%]	2.3 - 2.5
	Flexural modulus	[MPa]	45000 - 46000
INTERLAMINAR SHEAR STRENGTH (ASTM D 2344)	Short beam: E-glass unidirectional specimen Laminate thickness t = 3.1 - 3.25 mm Fibre volume content: 61 - 64 %		
	Shear strength:	[MPa]	60 - 62

**HANDLING
PRECAUTIONS****Personal hygiene***Safety precautions at workplace*

protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
<u>goggles/safety glasses</u>	yes

Skin protection

before starting work	Apply barrier cream to exposed skin
after washing	Apply barrier or nourishing cream

Cleansing of contaminated skin

Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents

Disposal of spillage

Soak up with sawdust or cotton waste and deposit in plastic-lined bin

Ventilation

of workshop	Renew air 3 to 5 times an hour
of workplaces	Exhaust fans. Operatives should avoid inhaling vapours

FIRST AID

Contamination of the *eyes* by resin, hardener or mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.

Material smeared or splashed on the *skin* should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.

Anyone taken ill after *inhaling* vapours should be moved out of doors immediately.

In all cases of doubt call for medical assistance.

Huntsman Advanced Materials

(Switzerland) GmbH
Klybeckstrasse 200
4057 Basel
Switzerland

Tel: +41 (0)61 299 11 11
Fax: +41 (0)61 299 11 12

www.huntsman.com/advanced_materials

Email: advanced_materials@huntsman.com



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